633

Operation Manual

MODEL 314

Vibration Analyzer

Operation Manual

MODEL 314

Vibration Analyzer

For S/N Prefix "J"

IRD MECHANALYSIS, INC.

SUBSIDIARY OF H. H. ROBERTSON COMPANY

6150 HUNTLEY RD. COLUMBUS, OHIO 43229

PHONE: 614/885-5376 CABLE ADDRESS: IRDMECH, USA

Copyright 1969 IRD MECHANALYSIS, INC. Cable Address: IRDMECH Columbus, Ohio Subject to change without notice.

#396D Litho in U. S. A.

WARRANTY

IRD MECHANALYSIS, INC. warrants that all of its products are free from defects in material and workmanship under normal use and authorized service for a period of one (1) year from the date of original shipment from **IRD M** factory warehouse with the exception of electronic parts. Electronic parts, i. e. tubes, relays, etc., are warranted for 90 days minimum or carry original manufacturer's warranty. Such defects will be corrected providing the equipment is returned to **IRD M** factory at the purchaser's expense.

This warranty does not apply to equipment showing abuse or damage or to equipment which has been altered or repaired by others except as authorized by **IRD M**. Nor does it extend to products which have been subjected to a corrosive and/or abnormal atmosphere.

In no event will responsibility be assumed or implied for consequential damages arising from interrupted operation or any other causes. Vibration levels and/or tolerances must be established by purchaser.

This warranty is in lieu of all other warranties express or implied and no one is authorized to assume any liability on behalf of **IRD M** or to impose any obligation on it in connection with the sale of any equipment other than as outlined above.

Contents

DESCRIPTION 1

OPERATION 5
Preparing The Analyzer 5
Obtaining Preliminary Data 7
Taking Initial Measurements 8
Over-All Vibration Measurements 9
Background Vibration Measurements 11
Vibration Identification 12
Vibration Tolerance Charts 13
Monitor Applications 15
Alarm Level Adjust Control 15
Scope Jack 15

BALANCING 17
Placing the Reference Mark 18
Weight Correction Procedures 18
Determing Amount of Trial Weight 18
Temporary Weight 20
Permanent Weight 20
Dividing Weights 21
Single-Plane Balancing, Trial Method 22
Fundamental Rules For Adjusting Trial Weight 23
Single-Plane Balancing, Vector Method 26
Two-Plane Balancing, Trial Method 28
Two-Plane Balancing, Vector Method 30

FIELD MAINTENANCE 33
Operation Test Chart 33
Pickup, Strob Light, & Meter Circuit Test 33
Filter Operation Test 34
Oscillator Test 34
Troubleshooting Chart 35
Calibration 36
Schematic 39
Parts List 40

ACCESSORIES 44
Manual Pickup Selectors & Recorders 44

Contents

Manual Selector, 2-Pickup Input–IRD/M Part #1734 44
Manual Selector, 4-Pickup Input–IRD/M Part #1735 45
Manual Selector, 6-Pickup Input–IRD/M Part #1736 45
Vibration Amplitude Recorder– IRD/M Part #4923 45
Pickups 46
Pickup Attachments 47
Magnetic Pickup Holder–IRD/M Part #4332 47
Shaft Stick–IRD/M Part #2475 47
Vise Grip Pickup Attaching Tool–IRD/M Part #1821 48
Magnetic Pickup Shield–IRD/M Part #1157 48
Traveling Cover & Compartment–Model IRD/M #1311 48
Cables 49
Balancing Computer, Model IRD/M 212 49
OTHER IRD/M PRODUCTS 50
Balancing Machines 50
GLOSSARY 51

Description 1

The completely portable Model IRD-314 Vibration Analyzer is a precise analytical instrument specifically designed to assist industry in obtaining improved performance, improved quality, and reduced costs in the operation of rotating machinery.

New applications of this industrial troubleshooting tool are being realized continuously. Areas in which the Model 314 has proven useful are –

- Preventive maintenance.
- Research and design of machinery.
- Development of vibration specifications for new products.
- Production checking and balancing of components.
- In-place checking and balancing of completed assemblies.
- Inspection of rotating components or assemblies from suppliers.
- Vibration monitoring.

By eliminating trial-and-error methods for the solution of vibration and balancing problems this economical and extremely versatile instrument assures better finish, closer tolerances, higher machine speeds, longer machine life and lower maintenance cost.

Basic principles, procedures, and applications for using this analyzer are covered in this manual. Continued usage will permit the development of operator skills and techniques.

2 Description

The electronic unit is enclosed in a rugged vinyl-covered aluminum cabinet capable of withstanding constant shop use. This compact, portable unit includes all rugged, quality components and printed circuits, designed for maximum sensitivity, versatility, accuracy and simplicity of operation.

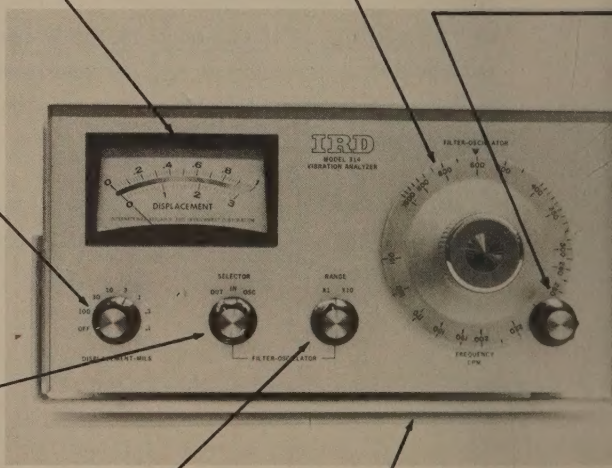
The controls, indicators and receptacles with which the operator should be familiar are:

FRONT VIEW

1. A variable FILTER/OSCILLATOR-FREQUENCY tuning dial calibrated in cycles per minute (may be tuned to any frequency between 150 and 15,000 cycles per minute).

2. A DISPLACEMENT meter presents the peak-to-peak vibration displacement directly in MILS (thousandths of an inch).

3. A DISPLACEMENT-MILS range selector contains power switch and permits selection of displacement ranges so that the pickup signal may be presented as one-third or more of full scale reading.



4. A FILTER-OSCILLATOR SELECTOR permits broad band vibration analysis in the Filter-Out position or analysis at a particular frequency or speed with Filter-In. Oscillator position bypasses the pickup signal for use of the instrument as a Strob-tachometer.

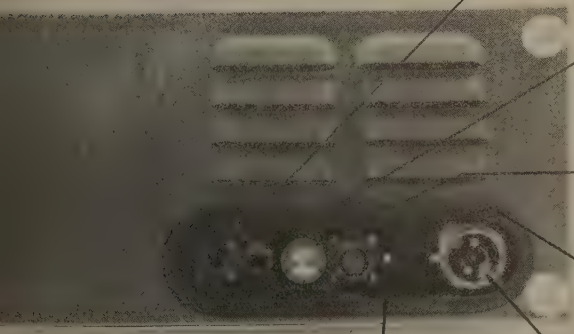
5. A FILTER-OSCILLATOR RANGE control in position X1 offers a selection of frequencies from 150 to 1500 cycles per minute and in the X10 position frequencies from 1500 to 15,000 cpm.

6. The carrying handle becomes a part of the frame when not in use.

TOP VIEW
Accessory Compartment

14. FUSE HOLDER: One Amp. Slo-Blo.

REAR VIEW



13. FILTER VERNIER TUNING DIAL

12. PICKUP RECEPTACLE.

11. SCOPE JACK RECEPTACLE.

10. ALARM LEVEL ADJUST permits monitor applications (see page 15). To be set at 0 for vibration analysis and balancing.

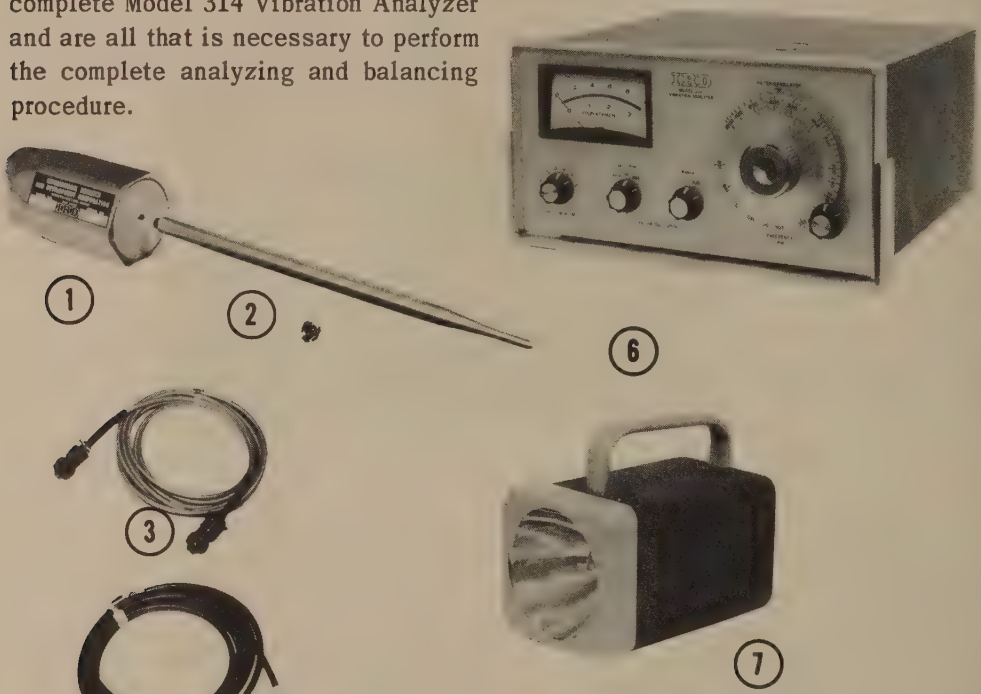
9. STROB RECEPTACLE.

8. POWER RECEPTACLE: 110 volt 50-60 cycles.

7. AUXILIARY POWER OUTLET.

4 Description

The following items are part of the complete Model 314 Vibration Analyzer and are all that is necessary to perform the complete analyzing and balancing procedure.



	DESCRIPTION	PART NO.
1.	Vibration Pickup	4526
2.	Straight Pickup Probe	1103
3.	Pickup Cable	2484
4.	Stroboscopic Light Cable	3875
5.	117 VAC Power Input Cable with Adaptor	2914
6.	Analyzer Console	3218
7.	Stroboscopic Light	4241

The console is provided with a convenient built-in storage compartment for accessories.

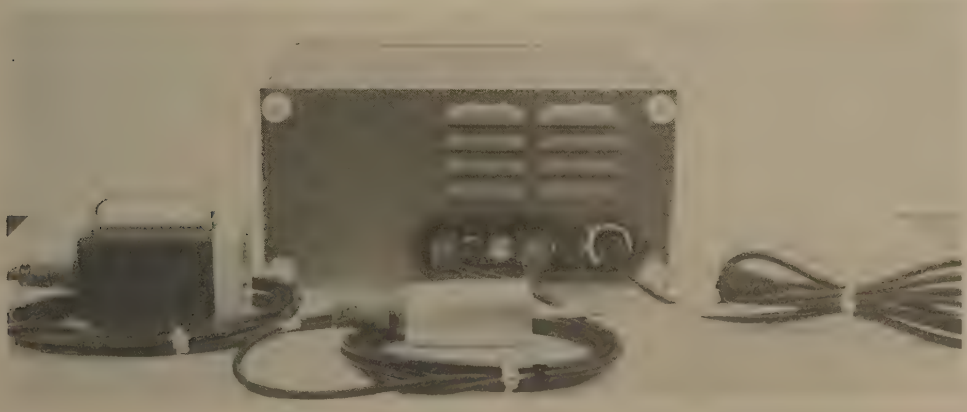
Special accessories required for unusual problems are found on page 44.

PREPARING THE ANALYZER FOR OPERATION

To prepare the Model 314 Vibration Analyzer for operation, proceed as follows --

1. Screw the pickup probe into the pickup unit.
2. Connect one end of the pickup cable to the pickup unit and the other end to the electronic unit receptacle.
3. Connect one end of the strob light cable to the strob light and the other end to the electronic unit receptacle.
4. Check for proper installation of fuse in fuse holder.

5. Connect the power cable to the electronic unit receptacle and to a 117 volt, 50/60 cycle outlet. If power outlet contains only two prong receptacle, use power cable adapter provided and connect small green wire from adapter to a suitable ground.
6. Set Alarm Level Adjust control (located on rear panel) to zero. Refer to page 15 for monitoring applications.



The Model 314 Vibration Analyzer is designed for use in locating and correcting vibration caused by rotating unbalance and as an aid in identifying other mechanical conditions resulting in vibration.

A rotating part which is unbalanced, will produce a vibration frequency in its bearing supports which is the same as its speed of rotation. Other mechanical malfunctions likewise produce a characteristic frequency of vibration. The instrument is capable of analyzing all such vibrations and will clearly indicate the rotating parts causing them. This requires that the many vibrations be compared or isolated. Accordingly, this section of the manual will divide the problem into three parts.

1. Obtain available preliminary data.
2. Isolate cause of vibration —— taking initial measurements.
   a. Take over-all vibration measurements.
   b. Take background measurements.
   c. Vibration identification.
3. Correct the trouble.
   a. Replace defective parts.
   b. Repair machinery when indicated.
   c. Balance by trial, vector, or computer method.

OBTAINING PRELIMINARY DATA

To obtain preliminary data which may prove helpful in determining the cause of the trouble and in locating the trouble when taking initial measurements, the following suggestions are offered:

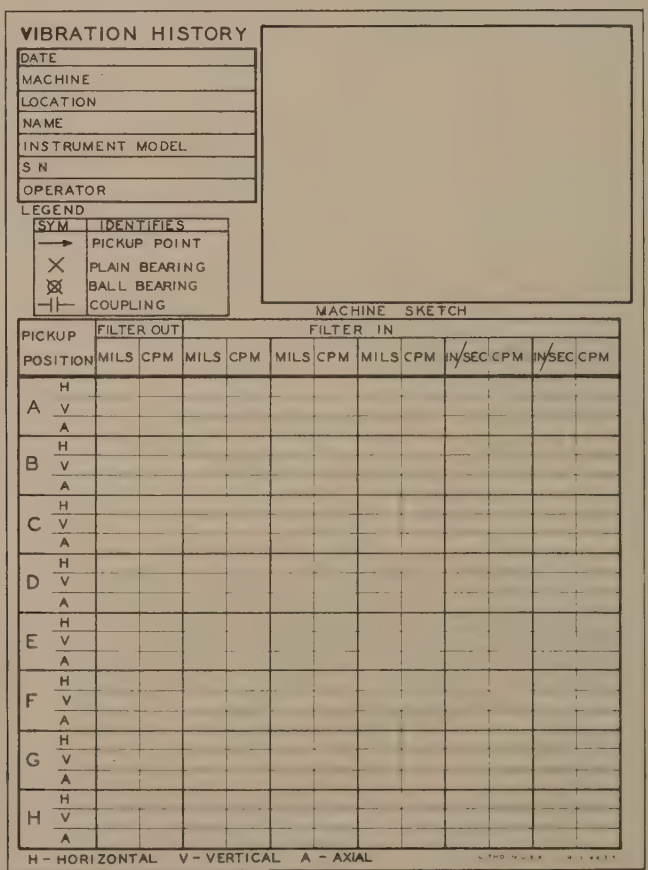
- Determine nature of trouble.
- Determine length of time trouble has been present.
- Find out if any changes were made prior to time trouble was first noted.
- Find out if any attempts have been made to correct this trouble or any previous troubles.

TAKING INITIAL MEASUREMENTS

The most important points for initial measurement are as follows:

- Main spindle bearing housing nearest to work.
- On the work head, in a line running through the centers of the spindle and the work.
- Points where amplitude of vibration is high.
- As close to bearings as possible.
- Directly on shaft, if it is true and has a smooth surface.
- On some equipment, housing, foundation, support or pipe or other extension may be used.

Since these measurements may be useful to the operator later, it would be sound procedure to record them. A typical chart for recording measurements is this Vibration History Form.



VIBRATION HISTORY

DATE
MACHINE
LOCATION
NAME
INSTRUMENT MODEL
S N
OPERATOR

LEGEND

SYM	IDENTIFIES
→	PICKUP POINT
X	PLAIN BEARING
⊠	BALL BEARING
⊣⊢	COUPLING

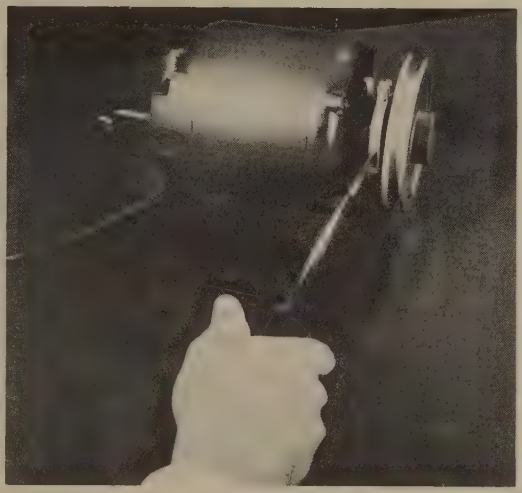
MACHINE SKETCH

PICKUP POSITION		FILTER OUT		FILTER IN							
		MILS	CPM	MILS	CPM	MILS	CPM	MILS	CPM	IN/SEC	CPM	IN/SEC	CPM
A	H												
	V												
	A												
B	H												
	V												
	A												
C	H												
	V												
	A												
D	H												
	V												
	A												
E	H												
	V												
	A												
F	H												
	V												
	A												
G	H												
	V												
	A												
H	H												
	V												
	A												

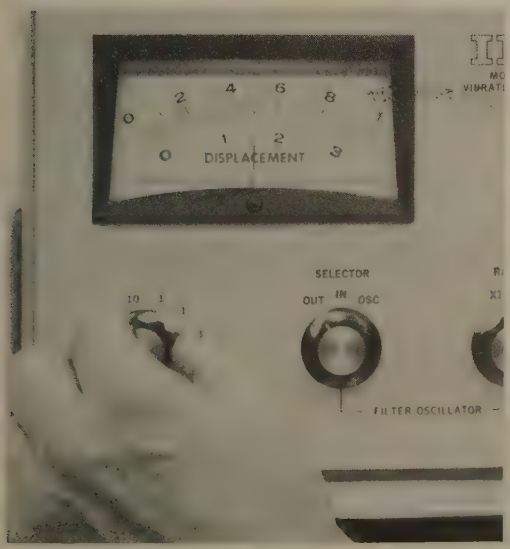
H - HORIZONTAL V - VERTICAL A - AXIAL

Over-all Vibration Measurements

1. Prepare the Model 314 Vibration Analyzer for operation.
2. Turn FILTER-OSCILLATOR SELECTOR to the OUT position.
3. Place vibration pickup on rotating equipment being analyzed.
4. Starting at the X100 position, turn the DISPLACEMENT - MILS selector until a reading of at least 1/3 full scale is obtained on DISPLACEMENT meter.



The meter face has two sets of graduations —— the top, from 0 to 1; the bottom, from 0 to 3. The setting of the DISPLACEMENT-MILS selector determines which graduation applies. If this setting is 100, 10, 1 or .1 use the top graduation in reading the meter, placing the decimal point where indicated by the DISPLACEMENT-MILS selector. Thus on the 100 setting full scale on the meter becomes 100 mils, .6 on the meter becomes 60 mils, etc. If the DISPLACEMENT-MILS selector is set on 30, 3, or .3 use the bottom graduation, placing the decimal in the same way.



Thus, in the example shown, the meter reading is .15 mils (using .3 range, on DISPLACEMENT-MILS selector). If it is wished to convert this reading to inches of displacement, multiply reading by .001; to convert to micro-inches multiply by 1000. Thus, the example could be expressed three ways:

.15 mils
.000 15 inches (.001 x .15)
150 micro-inches (1000 x .15)

This reading is the total sum of all the vibration signals in the machine, including background vibrations.

5. Direct strob light on the transmission system and various rotating components of the equipment being analyzed.

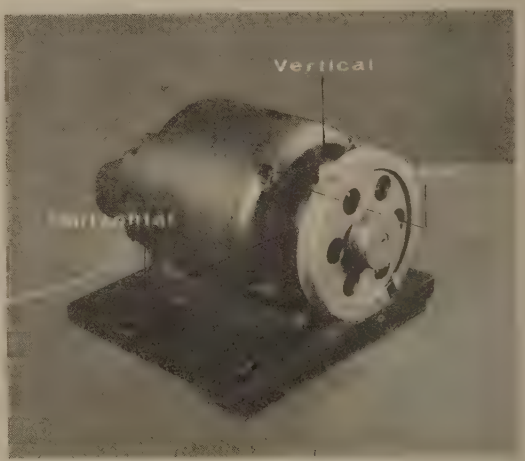
6. The part causing the most vibration will trigger the lamp in synchronization with its rotating speed and will appear to be stopped under the strob light.

> When components in the equipment are sealed and cannot be observed with the strob light, a blueprint of the equipment may be helpful to relate the speed of some interior part to the frequency of vibration.

7. If RPM of the part is known, move the FILTER-OSCILLATOR FREQUENCY dial to this frequency. If RPM is not known, it may be determined by placing the FILTER-OSC. SELECTOR in OSC. position and adjusting the FILTER-OSC. FREQ. dial until the component is observed in a fixed position with the strob light.

8. Turn the FILTER-OSC. SELECTOR to the IN position.

9. Place vibration pickup on the critical point located in Steps 4 and 5 and probe in the horizontal, vertical, and axial directions. Record displacement readings.



10. Setting FILTER-OSC. RANGE at X1, rotate the FILTER-OSC. FREQ. dial to obtain a peak or maximum DISPLACEMENT meter reading. Repate with RANGE at X10.

11. Record frequency readings. Where there are several components in a piece of equipment which can be operated separately, it is sometimes helpful to operate each component one at a time to determine which component causes the major vibration.

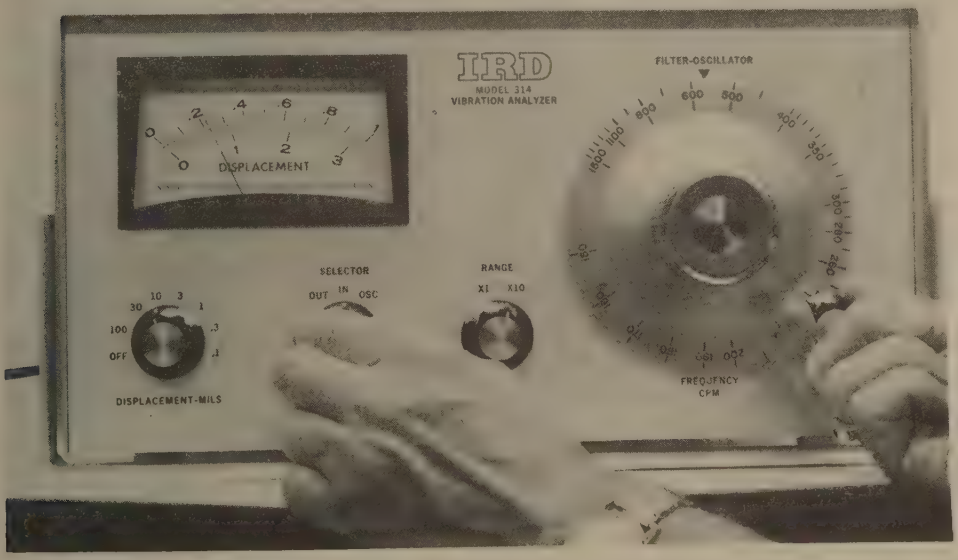
12. If cause of vibration is located and identified it may be advantageous to correct that cause of vibration and repeat Over-all Measurements, Steps 1 through 11 to make sure vibration is eliminated.

13. Record all measurements and corrections accomplished on the machine. This will aid in accomplishing work on the same machine and similar machinery, at a later date, and will provide permanent records of troubles located and corrected.

Background Vibration Measurements

If the foregoing procedures have failed to pinpoint the cause of the vibration, take background readings as follows:

1. Turn FILTER-OSC. SELECTOR to the OUT position.
2. With the equipment completely shut down, place vibration pickup on equipment.
3. Switch through DISP.-MILS ranges starting at X10 position.
4. If background vibration is detected, record for future correction of trouble. This is the lowest level of vibration to which the components can be balanced, if the variable filter is not used.
5. Turn FILTER-OSC. SELECTOR to the IN position.



6. Rotate the FILTER-OSC. FREQ. dial through the entire frequency spectrum (with FILTER-OSC. SELECTOR on X1 and then on X10) very slowly, using the vernier tuning dial, recording peaks that may occur on the DISPLACEMENT meter.
7. If readings can be obtained on DISPLACEMENT meter, try to relate frequencies to other rotating machinery in the area.

Vibration Identification

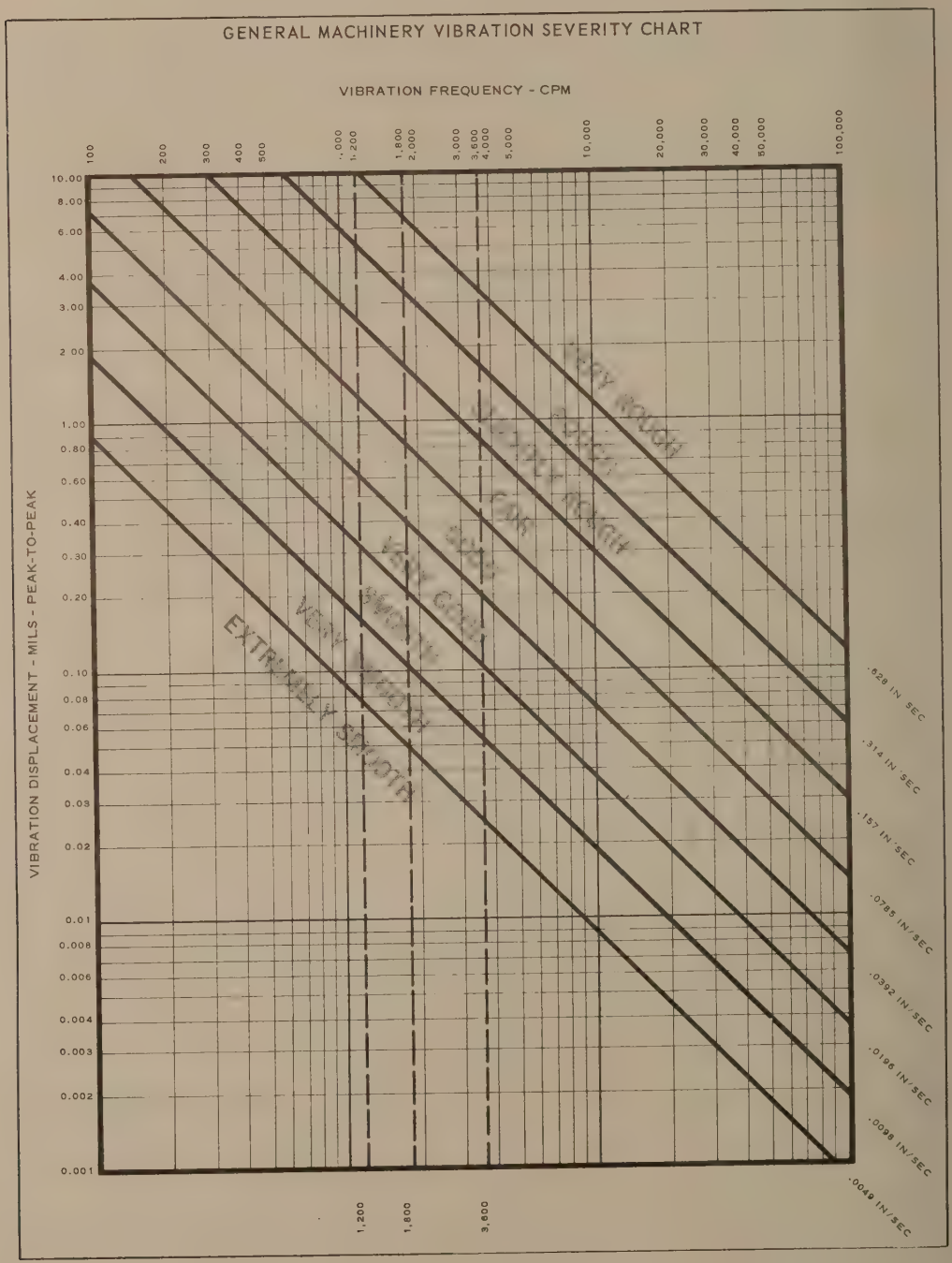
From the information obtained through initial measurements it must be determined if the vibration is due to an unbalanced condition, or another condition which cannot be corrected through balancing. The following information is provided to aid the operator in recognizing the type of vibration through information gathered with the 314 Vibration Analyzer. These are the causes most readily detected. As the operator acquires experience he will discover other causes of vibration.

CAUSE	DISPLACEMENT	FREQUENCY	PHASE	REMARKS
Unbalance	Proportional to unbalance. Largest in radial direction.	1 x RPM	Single reference mark.	Most common cause of vibration.
Misalignment couplings or bearings. Bent shaft.	Large in axial direction. 50% or more of radial vibration.	1 x RPM usual 2 & 3 x RPM sometimes	Single double or triple	Best found by appearance of large axial vibration. Use dial indicators or other method for positive diagnosis. If sleeve bearing machine and no coupling misalignment balance the rotor.
Bad bearings anti-friction type	Unsteady – use velocity measurement if possible	Very high several times RPM	Erratic or fanning reference mark	Bearing responsible most likely the one nearest point of largest high-frequency vibration.
Eccentric journals	Usually not large	1 x RPM	Single reference mark	If on gears largest vibration in line with gear centers. If on motor or generator vibration disappears when power is turned off. If on pump or blower attempt to balance.
Bad gears or gear noise	Low – use velocity measure if possible	Very high gear teeth times RPM	Erratic reference mark	
Mechanical looseness		2 x RPM	Two reference marks. Slightly erratic.	Usually accompanied by unbalance and/or misalignment.
Bad drive belts	Erratic or pulsing	1, 2, 3 & 4 x RPM of belts	One or two reference marks depending on frequency. Usually unsteady.	Strob light best tool to freeze faulty belt.
Electrical	Disappears when power is turned off	1 x RPM or 1 or 2 x synchronous frequency.	Single or rotating double reference mark	If vibration amplitude drops off instantly when power is turned off cause is electrical.
Aerodynamic hydraulic forces		1 x RPM or number of blades on fan or impeller x RPM		Rare as a cause of trouble except in cases of resonance.
Reciprocating forces		1, 2 & higher orders x RPM		Inherent in reciprocating machines can only be reduced by design changes or isolation.

Vibration Tolerance Charts

The following charts illustrate the severity of vibration which can be used for most machinery. The values are based on practical data obtained from a large number of machines and are useful as a guide. Wide variations from these values may be expected for individual machines. The General Machinery Vibration Severity Chart on page 14 applies to rotating equipment. For most precision machine tools the chart below may be used.

TYPE OF MACHINE	Displacement of vibrations as read with pickup on spindle bearing housing in the direction of cut.
Grinders	**Tolerance Range**
Thread Grinder	.01 — .06 mils
Profile or Contour Grinder	.03 — .08 mils
Cylindrical Grinder	.03 — .10 mils
Surface Grinder (vertical reading)	.03 — .2 mils
Gardner or Besly Type	.05 — .2 mils
Centerless	.04 — .1 mil
Boring Machine	.06 — .1 mil
Lathe	.2 — 1.0 mils

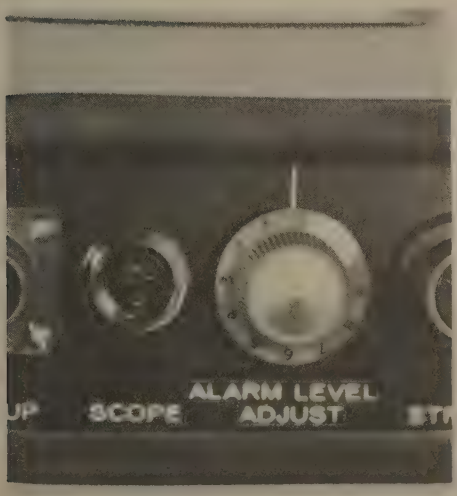

GENERAL MACHINERY VIBRATION SEVERITY CHART
VIBRATION FREQUENCY - CPM
100
200
300
400
500
1,000
1,200
1,800
2,000
3,000
3,600
4,000
5,000
10,000
20,000
30,000
40,000
50,000
100,000
VIBRATION DISPLACEMENT - MILS - PEAK-TO-PEAK
10.00
8.00
6.00
4.00
3.00
2.00
1.00
0.80
0.60
0.40
0.30
0.20
0.10
0.08
0.06
0.04
0.03
0.02
0.01
0.008
0.006
0.004
0.003
0.002
0.001
VERY ROUGH
EXTREMELY ROUGH
.629 IN/SEC
.314 IN/SEC
.157 IN/SEC
.0785 IN/SEC
.0392 IN/SEC
.0196 IN/SEC
.0098 IN/SEC
.0049 IN/SEC
1,200
1,800
3,600

MONITOR APPLICATIONS, Alarm Level Adjust Control

The purpose of this control is to provide a pre-set level of vibration displacement at which the strob light will fire, thus, the flashing strob becomes a signal.

The control is labeled ALARM LEVEL ADJUST and is located on the rear panel of the Model 314. The knob is calibrated in eleven increments from 0 to 10. The setting of the dial is related to full scale indication on the DISPLACEMENT meter and works in conjunction with the DISP.-MILS Switch. For example if it is desired to set the vibration level at which the strob will fire to 5 mils, simply set the DISPL.-MILS Switch to the 10-mil range and adjust the ALARM LEVEL ADJUST to 5 (the vertical white line on the rear panel is the indexing point). The strob light will then fire whenever the DISPLACEMENT meter indication exceeds 5 mils. There is some error in this setting but should never exceed ±1/2 major division. For precise settings, dial calibration is necessary. It is suggested that the dial be set at some level lower than the actual alarm level. In this manner the strob light will become a warning device, alerting responsible personnel that the machine under observation should be checked.

> **CAUTION**
>
> Whenever the Model 314 is to be used for balancing or vibration analysis, the ALARM LEVEL ADJUST control must always be set to 0. This is the point at which maximum strob sensitivity is obtained.



Scope Jack

The scope jack located on the rear panel of the Model 314 has two uses.

1. RECORDING FEATURE--By connecting a D.C. recorder (IRD/M Part No. 4923) to the scope jack the level of vibration may be logged for future reference. For further details on the OC recorder, refer to the Accessories section, page 45.

2. OSCILLOSCOPE FEATURE—The scope jack can be connected to an oscilloscope such as Hewlett-Packard Model 130-A, so that the waveform of the vibration being analyzed can be visually examined.

The level of vibration to which the machine may be balanced is dependent upon many factors, some of which are:

- The minimum vibration level necessary to obtain satisfactory operation from the machine.
- A maximum vibration level specified by commercial tolerances, or established tolerances. Refer to Vibration Tolerance Charts.
- The background level beyond which the vibration level at the critical points cannot be reduced without correcting sources of vibration outside the machine.
- The lowest level which can be obtained without major mechanical changes or redesign of the equipment.
- The level which has been proved to be satisfactory by previous experience on a particular machine.

To accomplish in-place balancing with the Model 314 Vibration Analyzer there are three basic methods of determining the location and the weight to be added or subtracted. These three methods are the TRIAL METHOD, the VECTOR METHOD, and the Model 212 Balancing COMPUTER METHOD.

The TRIAL METHOD is simple and convenient when the number of trial runs is not too important and the rotating part is easily started and stopped.

When time and the number of total runs are important, the VECTOR METHOD provides a more efficient balancing procedure.

The most efficient method of multi-plane balancing is obtained by the COMPUTER METHOD using the Model 212 Balancing Computer as an accessory in conjunction with the Model 314 Analyzer (see Accessories page 49).

Before balancing procedure is started it should be determined whether it requires single-plane or two-plane balancing. Single-plane problems involve rotating parts where the diameter is large as compared to the length. Two-plane problems involve rotating parts which are relatively long as compared to their diameter. Balancing procedures presented in the following text are:

Placing the Reference Mark

Determining the Trial Weight

Single-Plane Balancing
- Trial Method
- Vector Method

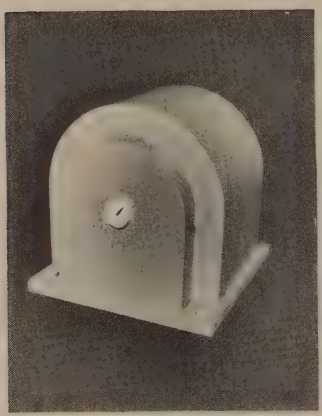
Two-Plane Balancing
- Trial Method
- Vector Method

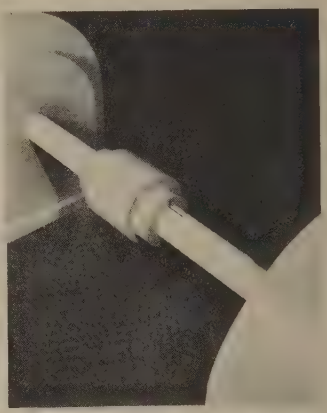
Dividing Weights

Weight Correction Methods

PLACING THE REFERENCE MARK

The placing of the reference mark is largely dependent upon the limitations of the part or machine being balanced. Some of the possible locations are:





- On the rotor, itself –– place mark radial to the axis.
- On the shaft of the rotor –– the mark may be at either end of the shaft, but all data must be taken using the same mark and pickup position.
- Around the outside of the rotating part –– a different marking technique must be used here, such as numbered tape.

> If slippage is suspected, place a mark across the junction as in right hand picture. This trouble must be corrected if accurate balancing is to be expected.

WEIGHT CORRECTION PROCEDURES

There are a number of critical factors involving weight that also must be considered before starting the balancing procedure. The amount of the trial weight must be determined; the methods for attaching it must be considered; and, it is sound to understand how the final correction will be made.

> CAUTION – Attach weights securely.

Determining Amount Of Trial Weight

If a trial weight which is too heavy is used during the initial balancing procedure it may cause damage to the equipment due to excessive vibration. If the trial

weight is too light, there will be little change in the vibration displacement. To find a reliable method for determining a proper trial weight, the following two formulas were established. The first formula should be used when the speed of the rotating component is below 1500 rpm. The second formula should be used when the speed of the rotating component is above 1500 rpm.

1. **Below 1500 rpm**

$$TW = \frac{WD}{4R}$$

TW = Trial weight (in pounds, ounces, or grams)
W = Rotor weight in same weight units as TW
D = Peak-to-peak displacement (in inches)
R = Radius in which weight is applied (in inches)

Example

W = 640 lb. (rotor weight)
D = .025 peak-to-peak displacement
R = 4 inches

$$TW = \frac{640 \times .025}{4 \times 4} = \frac{16}{16} = 1 \text{ lb.}$$

This means that a trial weight of 1 pound should be attached at any point 4 inches from the center of the rotating part.

2. **Above 1500 rpm**

$$TW \text{ (ounce-inches)} = \frac{5\% \text{ of Rotor Weight}}{1.75 \left(\frac{RPM}{1000}\right)^2}$$

Example

RPM = 2000 (same as setting on FILTER dial)
Rotor WEIGHT = 560 lbs.
5% of rotor weight = .05 x 560 = 28

$$\frac{28}{1.75 \left(\frac{2000}{1000}\right)^2} = \frac{28}{1.75 \times 4} = \frac{28}{7.0} = 4 \text{ ounce-inches}$$

This means that a weight of 4 ounces could be attached 1 inch from the center of the rotating part, at any point.

If it is not feasible to add a weight at the radius indicated, another radius can be used as long as the same number of ounce-inches results.

Attaching Temporary Weight

- Balancing clay or wax; adheres to rotating part.
- Bolts, nuts, and/or washers; affixed to tapped holes, threaded studs, or holes that run completely through rotating part.
- Clips and U-clamps; affix in such a way that centrifugal force will aid in holding the weights.
- Laminations of short lengths of tape, (for fine correction on very light components only).
- Weights soldered or fastened to metal baling bands strapped around the part.
- Balancing weight provided by part manufacturer.
- Material and method used by part manufacturer.

Attaching Permanent Weight

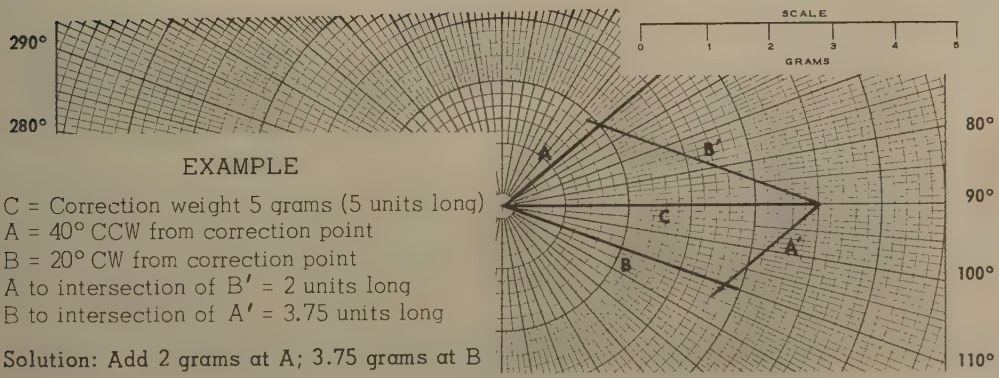
- Metal weights welded on rotating part, (include weight of welding rod).
- Solder.
- Material and method used by part manufacturer.
- Bolts, nuts, and/or washers; affixed to tapped holes, threaded studs, or holes that run completely through rotating part.
- Clips and U-clamps.
- Remove material on heavy area by drilling, grinding, or filing.

> When material is removed to obtain balance correction, make sure that weight is removed directly opposite from where the temporary weight was added.
>
> When the weight is being removed, check phase and displacement once or twice to be certain the exact heavy spot has been located, and to prevent removing too much material.

Dividing Weights

There may be occasions when the correction weight must be divided, e.g., when a weight cannot be added exactly at the point indicated by the balancing procedure. In such a case a vector solution is possible to locate the positions for the divided weight, by means of the following procedure–

- Determine two alternate positions (A and B) close to the point indicated by the balancing procedure. Compute the angle between A and B and the original correction point.
- Start your vector diagram by drawing a horizontal line from the center of a sheet of polar co-ordinate paper and make its length proportional to the amount of weight to be applied. Call this line C.
- Project line A from the center of the graph at the same angle to line C as the angle between A and the correction point.
- Project line B in the same manner.
- Starting at the other end of line C, construct a line parallel to line A and call it line A′.
- Construct line B′ parallel to line B in the same manner.
- The distance from the center of the polar co-ordinate paper to the intersection of line A and line B′ represents the amount of weight to be added at that point. (Use the same scale you used in projecting line C).
- The distance from the center of the polar co-ordinate paper to the intersection of line B and line A′ represents the amount of weight to be added at that point. (Use the same scale you used in projecting line C).



EXAMPLE

C = Correction weight 5 grams (5 units long)
A = 40° CCW from correction point
B = 20° CW from correction point
A to intersection of B′ = 2 units long
B to intersection of A′ = 3.75 units long

Solution: Add 2 grams at A; 3.75 grams at B

SINGLE-PLANE BALANCING, Trial Method

1. Attach or hold the pickup to the point chosen near the vibration part with the greatest displacement. (Pickup attaching accessories are shown on page 47).

> Use horizontal or vertical direction, whichever gives highest reading. Be sure that the location and position of the pickup are the same throughout the balancing procedure.

2. Turn machine ON and note direction of rotation.

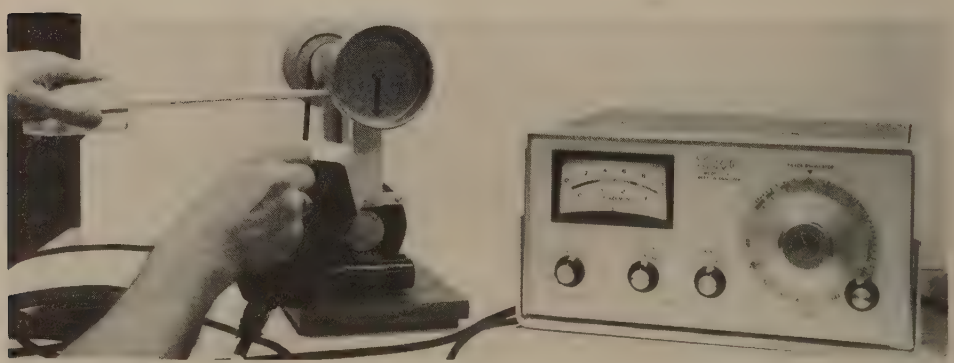
3. Turn FILTER-OSC. SELECTOR to IN. To obtain accurate phase indications (reference mark position) when filter is IN, speed variation should be less than 5%.

4. PLACEMENT meter. FILTER OSC. FREQ. dial must be tuned to rpm of part being balanced. Verify by turning FILTER OSC. SELECTOR to OSC. Part will be "frozen" by strob flash. Turn SELECTOR to IN.

5. Direct the strob on the rotating part being balanced.

6. Visualize the rotor as a clock face. Read the reference mark as if it were a clock hand. Record the position of the reference mark.

7. Record displacement as shown on DISPLACEMENT meter. This is the original reading.



In the photo: 6:00 phase, 1.5 mils displacement.

8. Stop the equipment and rotate by hand to place reference mark in position observed in Step 6.

9. Add a trial weight at any location on the rotating component. (See page 20 for methods of attaching trial weights).

CAUTION

Damage due to excessive vibration could result from a trial weight which is too heavy.

10. Turn on machine being balanced. Record the new displacement reading and the new reference mark position. If necessary, adjust DISP.-MILS selector.

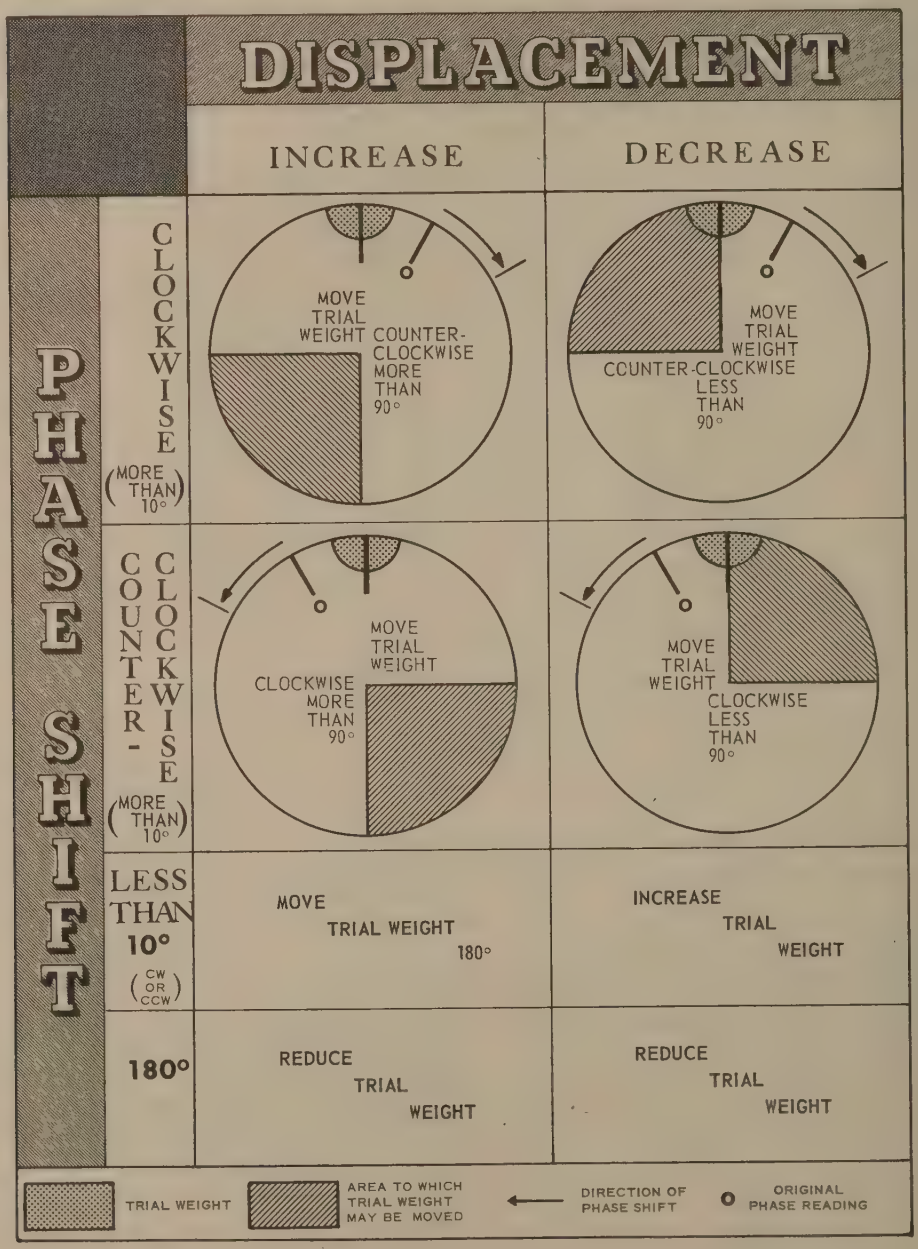
11. Compare the original phase position with that recorded after adding trial weight. Apply principles below in making adjustment of the trial weight.

FUNDAMENTAL RULES FOR ADJUSTING TRIAL WEIGHT

There are actually only a few combinations of displacement and phase changes that can result from adding the trial weight. The trial method of balancing uses this information to continually refine the amount and position of the trial weight until it is nearly equal and opposite of the heavy spot on the rotor.

As the operator gains experience, he will be able to refine his diagnosis of this information and balance in progressively less start-stop operations. However, the

fundamental rules shown here will be a great aid to the novice in learning how to perform the trial method of balancing; and they will serve as a check-off list for the experienced operator, to prove his diagnosis.



12. Apply and reapply the fundamentals of the chart until an acceptable tolerance is reached.

> Always compare the new readings to the original reading.

13. After the correct amount of weight has been determined, mark exact position of weight on rotating part.

14. Remove all of the trial weight from the rotating part, weigh and record. This is the exact amount of weight required to correct the unbalance when placed at the exact spot located during the balancing procedure.

15. Attach permanent weight to rotating part in exact location and radius of trial weight or subtract weight 180° opposite exact location of trial weight. (See page 20 for methods of adding or subtracting permanent weight).

16. Turn machinery on and check displacement reading on DISPLACEMENT meter. Meter should read vibration displacement well within acceptable tolerance of machine.

17. If other rotating parts of the machine require balancing, repeat Single-Plane Balancing, Trial Method, Steps 1 through 15 until all parts are balanced. (Move FILTER-OSC. SELECTOR switch to OUT position and check for other predominant vibrations with machinery running, by observing DISPLACEMENT meter and the various rotating parts with the strob light).

18. Balancing of other rotating parts of the same machinery may be accomplished without moving pickup. However, for maximum sensitivity, pickup should be placed on bearing housing nearest rotating part being balanced.

19. After the part is balanced, place the pickup in a position 90° from the one in which the part was balanced (if the part was balanced with the pickup in the horizontal position, move the pickup to the vertical position). If vibration level is unacceptable, re-balance the part by repeating Single-Plane Balancing, Trial Method, Steps 2 through 16 with pickup in new position.

20. Return pickup to original position and check again for vibration. If an unacceptable vibration level is still present, refer to Vibration Identification on page 12 to try and identify other types of vibration which may be present.

SINGLE-PLANE BALANCING, Vector Method

1. Review: Introductory paragraphs, Placing the Reference Mark, and Weight Correction Methods on pages 17, 18, 19 and 20.
2. Repeat Steps 1 through 8, under Single-Plane Balancing, Trial Method.
3. Draw line on a sheet of polar-coordinate paper at the same angle as that of the reference mark, with a length proportional to the displacement. Use any convenient scale. Call this line **A.**

EXAMPLE

Original Reading (Line A), 1.5 mils @ 6:00 (180°).

Trial Weight added 5 grams.

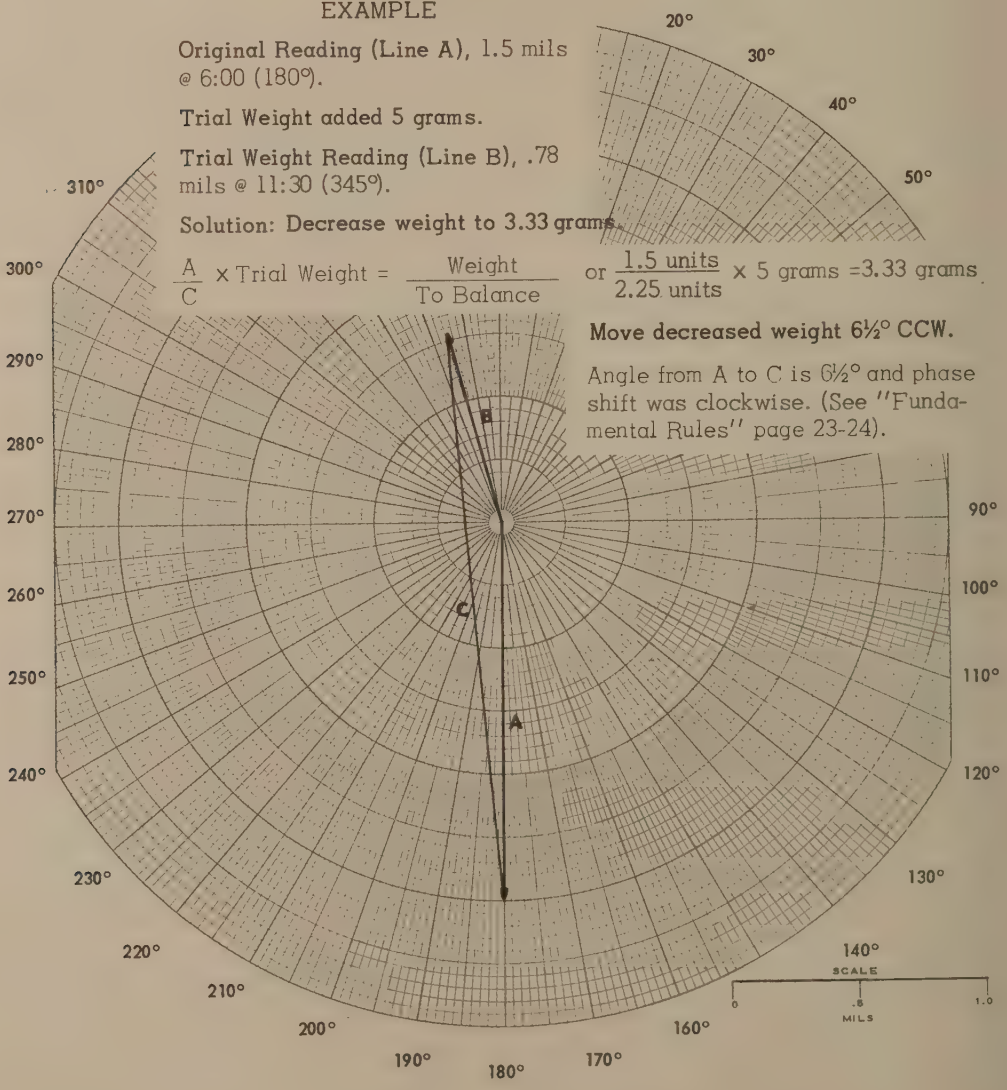
Trial Weight Reading (Line B), .78 mils @ 11:30 (345°).

Solution: Decrease weight to 3.33 grams.

$$\frac{A}{C} \times \text{Trial Weight} = \frac{\text{Weight}}{\text{To Balance}} \quad \text{or} \quad \frac{1.5 \text{ units}}{2.25 \text{ units}} \times 5 \text{ grams} = 3.33 \text{ grams}$$

Move decreased weight 6½° CCW.

Angle from A to C is 6½° and phase shift was clockwise. (See "Fundamental Rules" page 23-24).



4. Add a trial weight to rotating component.

5. Turn on machine being balanced.

6. Record the new reading on the DISPLACEMENT meter and the new reference mark.

7. Draw line on the polar paper at the same angle as that of the shifted reference mark with a length proportional to the displacement. Label this line B.

8. Draw a line from the end of line A to the end of line B and mark it C.

9. The angle (measure with protractor) between lines A and C tells the direction and number of degrees that the weight should be shifted. Check this against the fundamental rule – "shift the trial weight opposite the direction of the phase shift".

10. Determine the amount weight to be applied to the rotating part by multiplying the ratio length of line A to the length of line C times the trial weight.

    Because the diagrams cannot be 100% accurate and the length of the lines cannot correspond perfectly to the displacement readings, more runs may be necessary to balance to required tolerances.

11. If another run is necessary after the new weight is applied, repeat Steps 5 through 10, Single-Plane Balancing, Vector Method, using the same line A for a new vector diagram.

TWO-PLANE BALANCING, Trial Method

A second pickup and a selector switch may be obtained from IRD for speeding up the Two-Plane Balancing procedure. This will allow the operator to attach a pick-up to each bearing and switch to either one quickly.

1. Review: Introductory paragraphs, Placing the Reference Mark, and Weight Correction Methods on pages 17, 18, 19 and 20.

> The reference mark should always be observed at the same end of the part, regardless of which end is being balanced.

2. Place pickup at front end of rotating part and repeat Steps 2 through 7 of Single-Plane Balancing, Trial Method.

3. Place pickup at rear end of rotating part and repeat Steps 2 through 7 of Single-Plane Balancing, Trial Method.

4. Start at end of rotating part with greatest displacement and repeat Steps 8 through 12 of Single-Plane Balancing, Trial Method.

5. Place pickup at other end of rotating part and repeat Steps 8 through 12 of Single-Plane Balancing, Trial Method.

6. Check shifts of reference mark and displacement readings at both ends of rotating part.

7. If a finer balance is desired, start with the reference mark positions and displacement readings just obtained and repeat the above procedure using new weights (do not remove old weights), until acceptable balance is obtained.

8. Repeat Steps 13 through 16 of Single-Plane Balancing, Trial Method, at both ends.

9. After the part is balanced, place the pickup in a position 90° from the one in which the part was balanced (if the part was balanced with the pickup in the horizontal position, move the pickup to the vertical position). If the vibration level is unacceptable at either end, re-balance the part by repeating Steps 4 through 6 with pickup in new position.

10. Return pickup to original position and check each end again for vibration. If an unacceptable vibration level is still present, refer to Vibration Identification on page 12 to try and identify other types of vibration which may be present.

TWO-PLANE BALANCING, Vector Method

The VECTOR METHOD is more accurate than the TRIAL METHOD when solving a two-plane balancing problem.

To speed up the two-plane balancing procedure, a second pickup and selector switch may be obtained from IRD. This will allow the operator to attach a pickup to each bearing, and switch to either one when desired. (See pages 44 and 46).

1. Review: Introductory paragraphs, Placing the Reference Mark, and Weight Correction Methods on pages 17, 18, 19, and 20.

> The reference mark should always be observed at the same end of the part, regardless of which end is being balanced.

2. Place pickup at front end of rotating part and repeat Steps 2 through 7 of Single-Plane Balancing, Trial Method.

3. Place pickup at the rear end of rotating part and repeat Steps 2 through 7 of Single-Plane Balancing, Trial Method.

4. Start the balancing procedure at the end with the greatest displacement reading. Then repeat the same procedure for the other end. Draw a line on polar co-ordinate paper at the same angle as that of the reference mark, with a length proportional to the displacement. Call this line A_1. Use any convenient scale.

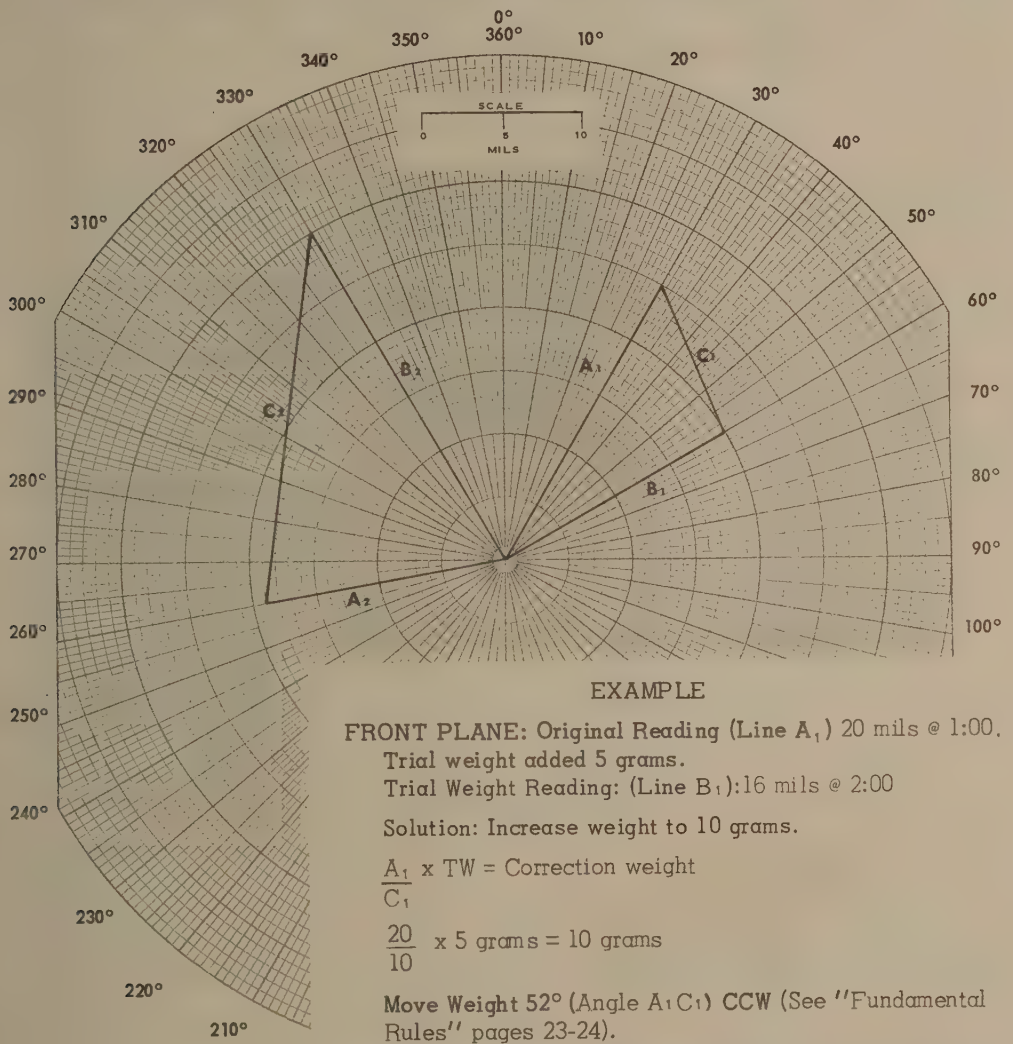
5. Stop machine and rotate part by hand until reference mark is in position observed. Add trial weight to rotating part, opposite pickup.

6. Turn on machine being balanced. Take readings from same plane and draw a line at the same angle as the new reference mark, with a length proportional to the new displacement. Label it B_1.

7. Draw a line from the end of line A_1 to the end of line B_1; label the line C_1.

8. The angle from line A_1 to line C_1 tells the direction and number of degrees the weight should be moved.

9. To determine the new weight to be applied to the rotating component, multiply the ratio of line A_1 length to line C_1 length, times the trial weight or



EXAMPLE

FRONT PLANE: Original Reading (Line A_1) 20 mils @ 1:00.
Trial weight added 5 grams.
Trial Weight Reading: (Line B_1):16 mils @ 2:00

Solution: Increase weight to 10 grams.

$$\frac{A_1}{C_1} \times TW = \text{Correction weight}$$

$$\frac{20}{10} \times 5 \text{ grams} = 10 \text{ grams}$$

Move Weight 52° (Angle A_1C_1) CCW (See "Fundamental Rules" pages 23-24).

REAR PLANE: Original Reading (Line A_2) 15.5 mils @ 8:40
Trial weight added 5 grams.
Trial weight reading: 24 mils @ 11:00

Solution: Reduce trial weight to 1.95 grams

$$\frac{A_2}{C_2} \times \text{Trial Weight} = \text{Correction Weight}$$

$$\frac{15.5}{23.5} \times 5 = 3.3 \text{ grams}$$

Move Weight 72° (Angle A_2C_2) CCW (See "Fundamental Rules" pages 23-24).

$$\left(\frac{A_1}{C_1}\right) \times \text{Trial Weight} = \text{Weight to Balance Part}$$

10. Remove trial weight and make the correction in the first plane.

11. Place pickup at the rear end of rotating component and repeat Steps 4 through 10 of this section. To distinguish between the front and rear planes, call the rear plane readings A_2, B_2, and C_2.

12. Turn on machine being balanced.

13. Check shifts of reference mark and displacement readings at front and rear ends of rotating part.

14. If a finer balance is desired, start with the reference mark positions and displacement readings just obtained in both planes for lines A_1 and A_2 and repeat Steps 4 through 13 using new trial weights (do not touch old weights), until acceptable balance is obtained.

Field Maintenance of the Model IRD-314 Vibration Analyzer should be limited to malfunctions which can be located and corrected without the use of electronic test equipment.

Simple test and correction procedures are provided in the Operation Test Chart and Troubleshooting Chart. These will assist the operator in determining when an easily-corrected malfunction has occurred. If these tests are performed and the operator or technician determines that the electronic portion of the vibration analyzer is inoperative, the analyzer, pickup, strob light and all cables should be returned to the factory for repair and calibration.

If local, qualified personnel with the proper test and calibration equipment is available to repair the instrument, the instrument may be recalibrated as outlined in this section.

CAUTION

The analyzer unit contains high internal voltage.

Replacing tubes in the analyzer unit may necessitate re-calibration to restore its accuracy and reliability.

OPERATION TEST CHART

These tests are provided to help the operator determine if all segments of the analyzer are performing their proper function after preparing analyzer for operation.

Pickup, Strob Light, and Meter Circuit Test

This test will permit the operator to determine if the pickup, strob light, and meter circuits are functioning. For these tests the controls are adjusted as follows:

Displacement Mils: The 100 position. (This turns the analyzer ON and the pilot lights should be lighted).

Filter Oscillator

Selector:	The OUT position.
Range:	Inoperative these tests.
Frequency Dial:	Inoperative these tests.

Grasp the pickup in the hand and shake it back and forth. A large amount of movement is not necessary -- a short, fast shake will give better results. The DISPLACEMENT meter will register more than a full scale reading and the strob light should fire intermittently in time with the shake rate. If the meter registers but the strob does not fire, press the switch button on the strob light handle and repeat the test.

Filter Operation Test

This test will indicate if the filter is working on the X10 range. The satisfactory completion of this test would usually indicate that the filter will also work on the X1 range. For this test the controls are to be left in the same position as the preceding test.

Disconnect the pickup from the pickup cable and insert the bare end of a piece of insulated wire, which is several feet long, into the B contact of the pickup cable.

Slowly turn the DISP.-MILS control clockwise until a substantial meter reading is obtained. Note the meter reading.

Turn the SELECTOR to the IN position and the RANGE to the X10 position. Turn the FILTER OSC. FREQ. dial to approximately 3600 cpm and tune for the largest meter reading. This reading should be approximately the same as that noted above.

Oscillator Test

This test will determine if the oscillator circuit is functioning. For the test the controls are adjusted as follows:

Displacement Mils: The 100 position.

Filter Oscillator

Selector: The OSC. position.

Range: The X1 position.

Turn the FILTER OSC. FREQ. dial slowly from 150 to 1500. The strob light should fire at an increasing rate as the dial is turned.

The RANGE control is then advanced to the X10 position and the test repeated. Although the strob light firing will change with the turning of the dial, it is easier to detect the change in firing rate when in the lower RPM, X1 range.

TROUBLESHOOTING CHART

The following chart is provided to aid the operator in locating the source of trouble in a malfunctioning analyzer without the use of electronic test equipment. The troubles are therefore limited to simple items which are readily observed.

1. **Pilot Light Does Not Light**
   a. CHECK POWER CABLE for visible defects, connections.
   b. CHECK PILOT LIGHT BULBS. **REMOVE ALL CABLES FROM ANALYZER,** lift cover and examine the two bulbs. Replace with G.E. No. 47 if defective.
   c. CHECK LINE FUSE
   d. CHECK AC OUTLET for proper voltage.

2. **Displacement Meter Indicates Little Or No Response From Pickup**
   a. CHECK PICKUP CABLE CONNECTIONS.
   b. TRY DISPLACEMENT-MILS selector on lower range.
   c. TEST ANALYZER FOR MALFUNCTION. With DISP.-MILS selector on X.1 and FILTER-OSCILLATOR selector at OUT touch right pin of PICKUP INPUT with screwdriver. If unit is operating, meter will register.
   d. TEST PICKUP CABLE. With pickup cable connected to analyzer and same setup as 2.c. insert wire in each of the connector holes of the free end of the cable. A reading on the DISPLACEMENT meter will prove the cable is operative. Repair or replace if defective.
   e. TEST PICKUP. With same setup as 2.d., connect pickup to cable. Shake pickup back and forth. Meter should peg. If no reading is noted return pickup for repairs.

3. **Strob Dead Or Fires Occasionally**
   a. Check to see that ALARM LEVEL ADJUST is set at zero (o). See page 15.
   b. DEFECTIVE BULB--remove the two screws on the sides of the bezel and remove the bezel, lens and reflector. Remove old bulb (pull straight out) and check by replacement.
   c. Check cable for defects.

Calibration of the Model 314 for use with its Vibration Pickup involves the use of an audio signal generator. The signal generator, in effect, replaces the Vibration Pickup in this calibration procedure to simulate a signal output equal to the pickup signal at a given frequency. This signal is then applied to the input of the Model 314 and the GAIN CALIBRATION CONTROL adjusted to read the displacement corresponding to that pickup signal input.

The sensitivity of the Model IRD/M 544 Vibration Pickup supplied with the Model 314 is 240 millivolts RMS ±10% at 100Hz (cycles per second) for a 1 mil (25.4 microns) peak-to-peak displacement. For Vibration Pickups with a serial number with a prefix "C" and above, the exact sensitivity of the Pickup is indicated by the last three digits of the Pickup serial number. For example, for a Pickup with serial number D4736242, the output is 242 MVRMS for a 1 mil shake at 100 Hz.

If your Pickup does not have a serial number with prefix "C" or above, this information can be supplied in most cases by IRD MECHANALYSIS in the form of MVRMS/100 Hz/ mil P-P. Always include the Pickup Model number e. g. 544 or 546 and the complete serial number when requesting this information.

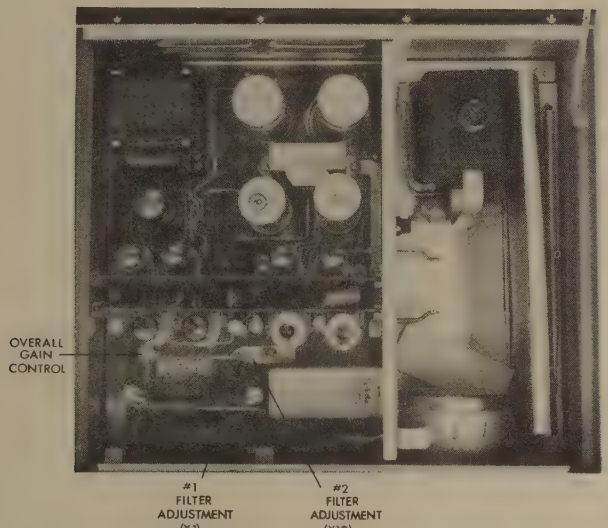
For identification and location of the ADJUSTMENT CONTROLS, see the illustration on page 37. The procedure for calibrating the Model 314 is as follows:

DISPLACEMENT METER ZERO ADJUSTMENT

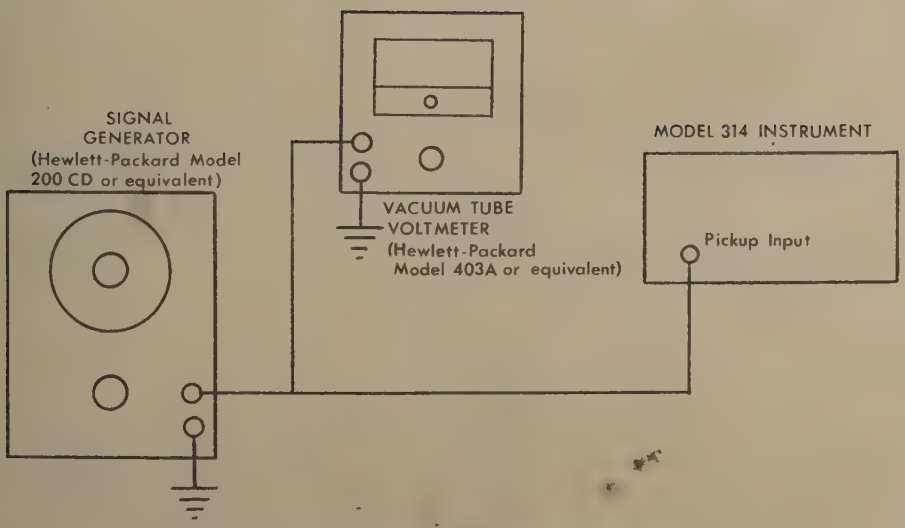
1. Set the Displacement-Mils switch at the OFF position.
2. Adjust the small screw located at the front center of the meter until the indication is exactly zero.

OVERALL GAIN ADJUSTMENT

1. Connect the output of a signal generator to the pickup input connector on the rear panel of the Model 314, and connect the AC VTVM in parallel with the input signal. See the block diagram, page 37 for this setup.
2. Set the Model 314 Displacement-Mils Switch at the 1 mil position.
3. Set the signal generator's output frequency at 100Hz.
4. Adjust the signal generator output signal for a reading on the AC VTVM equal to the known sensitivity of the Model 544 Pickup used, as indicated by the last three digits of the Pickup serial number (serial numbers with prefix "C" or above). If the Pickup sensitivity is not known, a preliminary gain adjustment can be made using the 240 MVRMS value.
5. Adjust the OVERALL GAIN CONTROL for a full scale reading on the 314 Displacement Meter.



Adjustment Control Locations

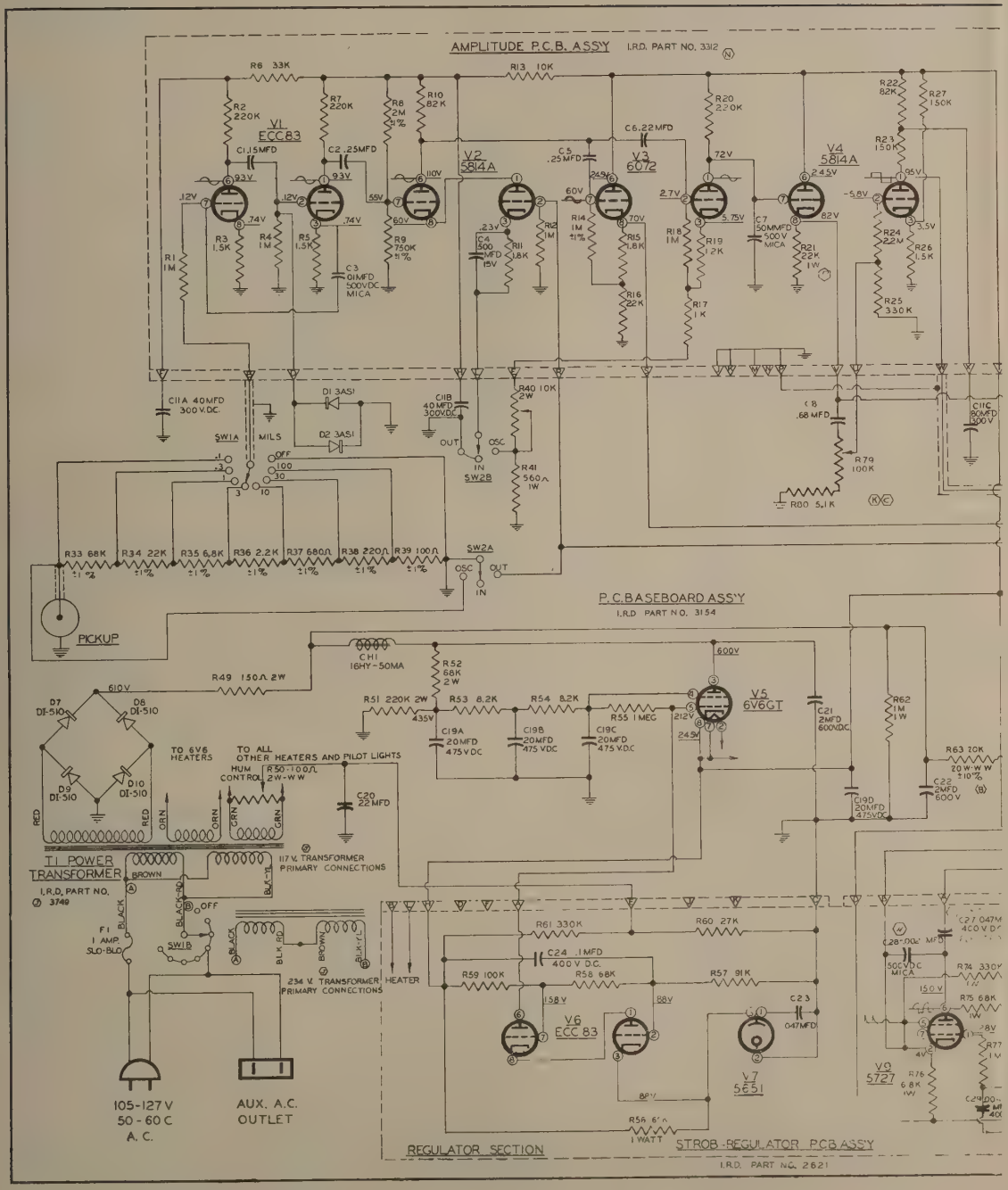


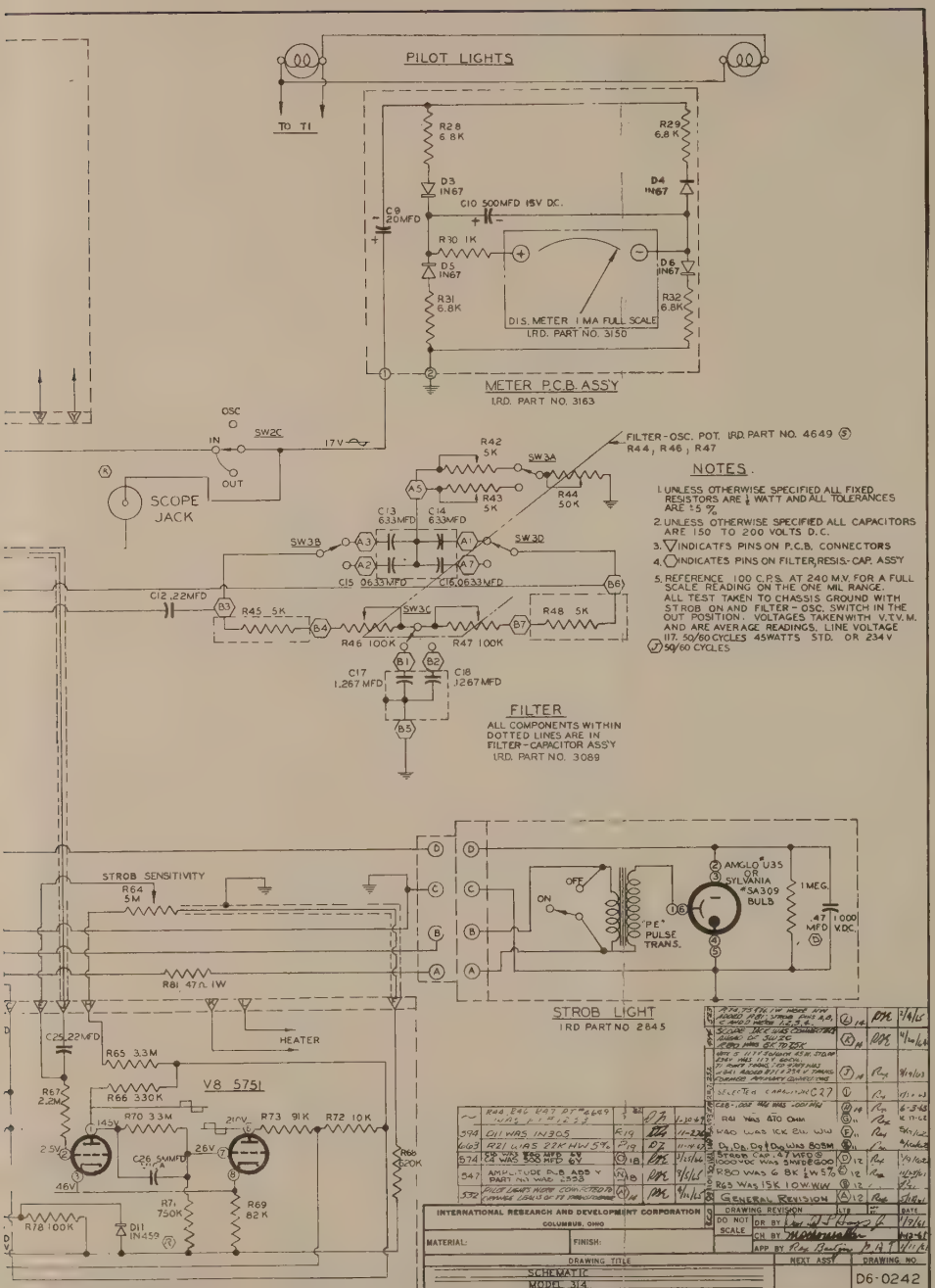
Block Diagrams Calibration Setup

CALIBRATION OF THE TUNEABLE FILTER

The Filter Adjustment Controls should be checked for proper adjustment when the tubes in the filter are replaced or whenever the IN and OUT filtered Displacement Meter readings differ appreciably with a sinusoidal input to the instrument. To adjust the filter circuits for proper operation proceed as follows:

1. Set the Displacement-Mils Switch at the 1 mil position.
2. Set the instrument's Filter-Osc Selector Switch at OUT.
3. Set the Frequency Range Switch at X1.
4. Adjust the signal generator's output frequency to 20 Hz.
5. Adjust the signal generator's output attenuator for a Displacement Meter reading ing of exactly 9/10 of full scale.
6. Switch the Filter-Osc Selector to IN.
7. Turn the Filter Tuning Dial to approximately 1200 CPM and slowly adjust for the peak reading on the Displacement Meter. A peak meter indication of 9/10 full scale should be observed, as was the case in the OUT position (step 5).
8. If the IN and OUT meter indications are not exactly the same, adjust the Filter Adjustment Control No. 1 until correlation is attained. Always rock the Filter-Osc Dial back and forth to assure an accurate adjustment.
9. Set the Filter-Osc Switch at OUT.
10. Set the instrument's Frequency Range Switch at X10.
11. Adjust the signal generator's output frequency to 200Hz.
12. Adjust the signal generator's output attenuator for a Displacement meter reading of exactly 9/10 of full scale.
13. Switch the Filter-Osc Selector to IN.
14. Turn the Filter Tuning Dial to approximately 12,000 CPM and slowly adjust for the peak reading on the Displacement Meter. A peak meter indication of 9/10 full scale should be observed, as was the case in the OUT position (step 12).
15. If the IN and OUT meter indications are not exactly the same, adjust the Filter Adjustment Control No. 2 until correlation is attained.


AMPLITUDE P.C.B. ASS'Y
I.R.D. PART NO. 3312
V1 ECC83
V2 5814A
V3 6072
V4 5814A
V5 6V6GT
V6 ECC 83
V7 5651
V8 5727
P.C. BASEBOARD ASS'Y
I.R.D PART NO. 3154
PICKUP
SW1A
SW1B
SW2A
SW2B
MILS
TO 6V6 HEATERS
TO ALL OTHER HEATERS AND PILOT LIGHTS
HUM CONTROL R50-100Ω 2W-W W
TI POWER TRANSFORMER
I.R.D. PART NO. 3749
117 V. TRANSFORMER PRIMARY CONNECTIONS
234 V. TRANSFORMER PRIMARY CONNECTIONS
HEATER
105-127 V 50-60 C A. C.
AUX. A.C. OUTLET
REGULATOR SECTION
STROB-REGULATOR P.C.B. ASS'Y
I.R.D. PART NO. 2621



594	C11 WAS 1N305	F/9	BM	11-22-60	
603	R21 WAS 27K 1W 5%	D7	DZ	11-14-60	
574	C8 WAS 500 MFD 6V	C/8	DZ	11-14-60	
547	AMPLITUDE P.C.B. ASS'Y PART NO WAS 3253	K/8	DZ	9/16/60	
532		K/8	DZ	9/16/60	

	R64 WAS 1MEG		DZ	9/16/60
	C25 WAS .22MFD		DZ	9/16/60
	R81 WAS 47Ω 1W		DZ	9/16/60
	C26 WAS .5MMFD		DZ	9/16/60
	R78 WAS 100K		DZ	9/16/60
	D11 WAS IN459		DZ	9/16/60
	R70 WAS 3.3M		DZ	9/16/60
	R73 WAS 91K		DZ	9/16/60
	R72 WAS 10K		DZ	9/16/60
	R66 WAS 220K		DZ	9/16/60
	R71 WAS 750K		DZ	9/16/60
	R69 WAS 82K		DZ	9/16/60
	C17 WAS .1267MFD		DZ	9/16/60
	C18 WAS .1267MFD		DZ	9/16/60
	C12 WAS .22MFD		DZ	9/16/60
	R45 WAS 5K		DZ	9/16/60
	R48 WAS 5K		DZ	9/16/60
	R46 WAS 100K		DZ	9/16/60
	R47 WAS 100K		DZ	9/16/60
	R42 WAS 5K		DZ	9/16/60
	R43 WAS 5K		DZ	9/16/60
	R44 WAS 50K		DZ	9/16/60
	C13 WAS .633MFD		DZ	9/16/60
	C14 WAS .633MFD		DZ	9/16/60
	C15 WAS .0633MFD		DZ	9/16/60
	C16 WAS .0633MFD		DZ	9/16/60
	R45 WAS 5K		DZ	9/16/60
	R48 WAS 5K		DZ	9/16/60
	R46 WAS 100K		DZ	9/16/60
	R47 WAS 100

SCHEMATIC REF. #	IRD PART #	DESCRIPTION
R37	1545	680 Ohm 1%
R38	1544	220 Ohm 1%
R39	1543	100 Ohm 1%
R40	1283	10k 2w
R41	1629	560 Ohm 1w
R42	4516	5k Pot.
R43	4516	5k Pot.
R44	4649	3 gang Pot.
R45	3089	5k
R46	4649	3 gang Pot.
R47	4649	3 gang Pot.
R48	3089	5k
R49	1717	150 Ohm 2w
R50	1281	100 Ohm 2w
R51	2945	220k 2w
R52	3099	68k 2w
R53	1595	8.2k
R54	1595	8.2k
R55	1614	1m
R56	1645	68k 1w
R57	1604	91k
R58	1602	68k
R59	1605	100k
R60	1599	27k
R61	1610	330k
R62	1660	1m 1w
R63	2907	20k 20w 10%
R64	1288	.5m Pot.
R65	1620	3.3m
R66	1610	330k
R67	1618	2.2m
R68	1612	620k
R69	1603	82k
R70	1620	3.3m
R71	1613	750k
R72	1596	10k
R73	1604	91k

SCHEMATIC REF.#	IRD PART #	DESCRIPTION
R74	1656	330k 1w
R75	1645	68k 1w
R76	1635	6.8k 1w
R77	1614	1m
R78	1605	100k
R79	3309	100k Pot.
R80	4299	5.1k 5%
R81	4310	47 Ohm 1w
Capacitors		
C1	1425	.15 MFD 200V 10%
C2	1455	.25 MFD 200V 20%
C3	1445	.01 MFD 500 VDC 5%
C4	3613	500 MFD 15V
C5	1455	.25 MFD 200V 20%
C6	1424	.22 MFD 200V 10%
C7	1471	50 MMFD 500V 5%
C8	1448	.68 MFD 200V 10%
C9	1480	20 MFD 150V
C10	3613	500 MFD 15VDC
C11	1305	40–40–80 MFD 300V
C12	1424	.22 MFD 200V 10%
C13	3089	.633 MFD
C14	3089	.633 MFD
C15	3089	.0633 MFD
C16	3089	.0633 MFD
C17	3089	1.267 MFD
C18	3089	1.267 MFD
C19	1307	20–20–20–20 MFD 475VDC
C20	1424	.22 MFD 200V 10%
C 21	1298	2 MFD 600V
C22	1298	2 MFD 600V
C23	1446	.047 MFD 200V 10%
C24	1433	.1 MFD 400VDC 10%
C25	1424	.22 MFD 200V 10%
C26	1472	5 MMFD 500V 20%
C27	1434	.047 MFD 400VDC 10%
C28	3874	.0022 MFD 500V 5%

SCHEMATIC REF.#	IRD PART #	DESCRIPTION
C29	1453	.0047 MFD 400V 10%
Diodes		
D1	1376	3AS1
D2	1376	3AS1
D3	1380	1N67A
D4	1380	1N67A
D5	1380	1N67A
D6	1380	1N67A
D7	3477	DI-510
D8	3477	DI-510
D9	3477	DI-510
D10	3477	DI-510
D11	4919	1N459A
Tubes		
V1	1386	ECC 83
V2	1408	5814 A
V3	1409	6072
V4	1408	5814 A
V5	1396	6V6GT
V6	1386	ECC 83
V7	1404	5651
V8	1407	5751
V9	1406	5727
Miscellaneous		
T1	3749	117/234V 50/60C Power Transformer
F1	1510	1Amp Slo Blow
F2	1516	Fuse Holder
CH1	2342	16 H -50MA
SW1	3143	Amplitude Range SW
SW2	3092	Filter Oscillator SW
SW3	3149	Filter Range SW
	3151	Aux. A. C. Outlet
Pilot Lights	1526	Lamp 6V
	3150	Meter

The standard accessories supplied with the Model IRD-314 Vibration Analyzer are sufficient to perform vibration analysis and dynamic balancing procedures.

In some cases, however, problems exist which justify additional accessory equipment to reduce the time required to perform a particular operation, or to simplify a procedure.

The applications of these products discussed here are only examples of their many uses. Consult IRD for answers to specific problems.

This group of products classified "Accessories" is available to IRD customers direct or through their local distributor. Prices and production schedules are available on request.

MANUAL PICKUP SELECTORS AND RECORDERS

Manual Selector, 2-Pickup Input–IRD Part #1734 (illustrated)

Rapid, accurate readings from two vibration measurement points are possible using this manual selector. By means of this accessory two pickups mounted on one machine or two different machines can be connected to the analyzer via standard IRD pickup cables.

In two-plane balancing procedures, this provides a fast check of displacement and phase in each of the planes. Also, since the pickups are mounted in a fixed position, both readings will tend to be more accurate than the readings taken when the pickup is hand-held.

This, or one of the following selectors can also be used to save time in recording data for preventive maintenance. Two to ten pickup signals can be fed into the selector, and the operator can read and record the displacement from the analyzer by switching through the various channels. Up to one hundred feet of pickup cable can be used to connect the pickups to the selector without appreciably reducing the signal.

This selector is mounted in a 2½" x 2½ x 2¼" steel box with a anodized aluminum finish. The flanges on each side are drilled for permanent mounting. The 2-position selector switch on the front of the selector has a black face with white numbers. One pickup input connector extends from each side. The input to the analyzer is connected to the rear of the selector.

Manual Selector, 4-Pickup Input—IRD Part #1735

This selector has the same applications as IRD Part #1734. It accommodates two to four pickup inputs and is connected to the analyzer in the same manner. Its dimensions are 4" x 5" x 3" with all four inputs located on the top of the selector.

Manual Selector, 6-Pickup Input—IRD Part #1736

This selector is identical to the #1735 in size and location of the pickup inputs, however, it accommodates from two to six pickup inputs. Its applications are the same as those mentioned for IRD Part #1734.

PICKUPS

The following Vibration Pickups are recommended for use with the Model 314 Vibration Analyzer. They are of the velocity type. These pickups produce an electrical impulse directly proportional to the velocity of the applied shake, in a direction parallel to the pickup axis, and have an operable range of 2 to 2500 CPS.

The 544 response is essentially linear from 12 to 1000 CPS and drops off exponentially, as the square of the frequency, below 12 CPS. For example, at a given velocity, the output at 12 CPS will be four times the output at 5 CPS, and eight times the output at 2.5 CPS.

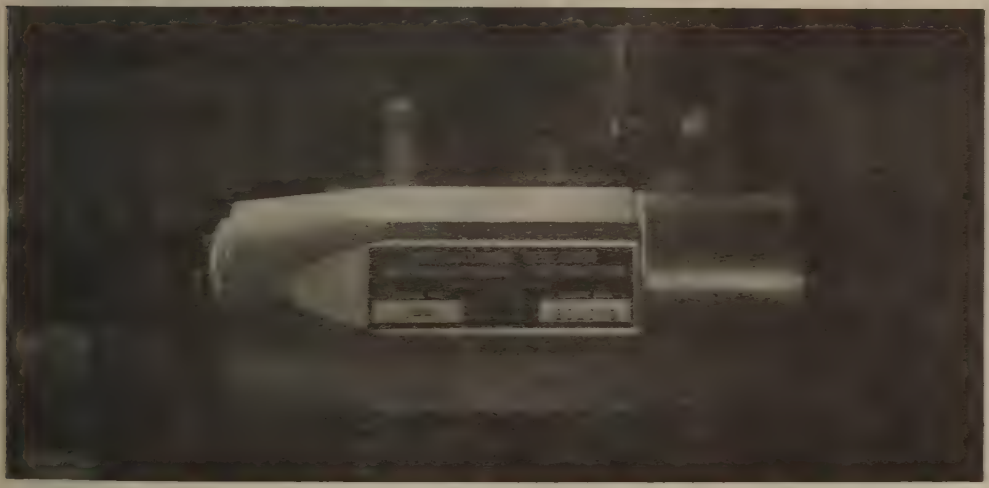
- MODEL 544–This is the standard pickup supplied with the analyzer. It is operable between −40° and +500° F. The output is directly proportional to the velocity of the case movement.

MODEL 546 D.P.–This pickup is for use in cases where it is physically impossible to mount the pickup to the workpiece. It is equipped with a prod mounted directly to the generating mechanism. The output is directly proportional to the velocity of the prod movement. The case must be firmly supported and isolated from the workpiece. Temperature range −40° F to 250° F. Frequency response +5% 2.5 to 2500 CPS.

PICKUP ATTACHMENTS

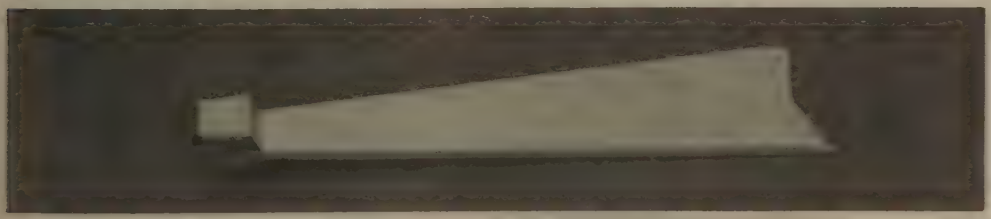
Magnetic Pickup Holder–IRD Part #4332

This pickup attaching tool permits attachment of an IRD pickup to any smooth ferrous surface without holding the pickup and without tapping the surface for a stud to which to mount the pickup. A powerful permanent magnet will usually hold the pickup in the position placed without movement for accurate vibration readings. The holder is 2-1/8" in diameter by 1-7/8" high. There is a ¼-28 stud provided for mounting the pickup without tools.



Shaft Stick–IRD Part #2475

The shaft stick is a convenient extension and balancing service for making readings on rotating shafts or to enable the operator to reach between closely-spaced rotating members. It is approximately 17" long and is made from dense oak and is fitted with a stud for quick attachment to the pickup.



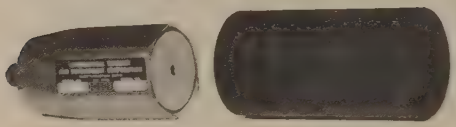
Vise Grip Pickup Attaching Tool–IRD Part #1821

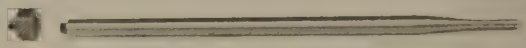
This accessory is another pickup attaching tool and can be attached to any flange or protrusion as shown in the illustration. The tool is fabricated so that the pickup is mounted parallel to the jaws of the vise grips.

Magnetic Pickup Shield–IRD Part #1157

This accessory is available to reduce the effects of a strong magnetic field in an area where the pickup must be mounted. It is a simple device for reducing the effect of magnetic attraction by a factor of 10:1. On special orders, a similar shield can be purchased that has a 40 db attenuation offering a 100:1 reduction in the effects of a magnetic field. (IRD Part #3563)

This accessory is quickly attached to the pickup. It can be used with the straight probe attached or can be attached to any stud to which pickup can be mounted.





TRAVELING COVER AND COMPARTMENT–MODEL IRD–1311

This cover can be used on either IRD Model 212 or IRD Model 314. It protects the control knobs from damage when transporting or storing the instrument, as well as providing extra storage space for pickup cables, charts, etc. The compartment is equipped with a positive spring lock that cannot come open accidentally. The internal measurements of the compartment are 2-1/2" x 6-3/4" x 14-1/4". Two spring clips lock securely at top to instrument bezel and at bottom to special clip which is easily attached to the instrument.

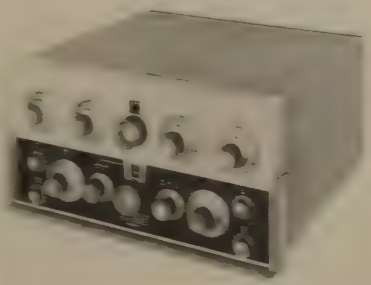
CABLES

Additional cables are available in the following lengths:

	IRD Part No.
4-foot Pickup Cable	2482
12-foot Pickup Cable	2484
25-foot Pickup Cable	2485
50-foot Pickup Cable	2486
75-foot Pickup Cable	2487
100-foot Pickup Cable	2488
15-foot High-Temperature Pickup Cable	2495
50-foot High-Temperature Pickup Cable	1496
12-foot Strob Cable	4145
25-foot Strob Cable	4146
50-foot Strob Cable	2493
100-foot Strob Cable	2494
Power Cable with Adaptor	2914
Power Extension	2504

BALANCING COMPUTER MODEL IRD–212

The balancing procedure referred to on page 17 as the COMPUTER METHOD requires an IRD Model 212 Balancing Computer to be used as an accessory with the analyzer. This revolutionary development is more accurate, faster, and simpler than any other known method of balancing. The Model 212 determines the amount of, and pinpoints the location of, the correction weight without diagrams or calculations.

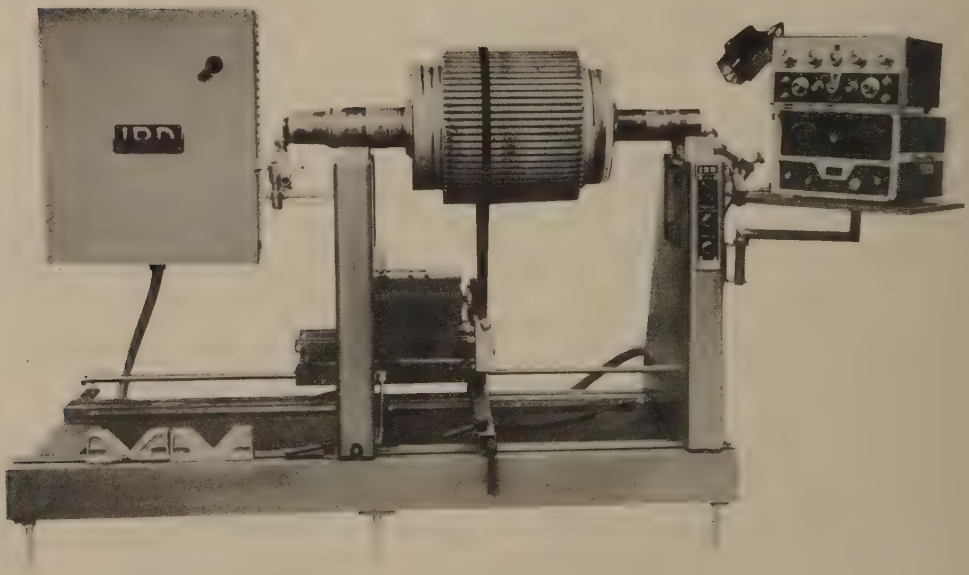


- IN-PLACE BALANCING—Single-plane problems are solved in two start-stop runs. Two-plane problems require three runs and can often be balanced in fifteen minutes. Multi-plane problems require more runs but are equally simple to solve.

- PRODUCTION BALANCING WITH A BALANCING MACHINE—After the initial calibration for each workpiece, correction weight and location data is determined instantaneously.

BALANCING MACHINES

These multi-purpose balancing systems are designed for production balancing—— where fast, simple operation is important, for Plant Maintenance——where quick, easy, setup is required, for Motor Repair and Service Shops——where versatility and capacity range is essential.



BALANCE (In a Rotating Component): A state of equilibrium in the mass distribution of a rotating component (no appreciable disturbing forces, vibrations, are present at the bearings or supports).

DISPLACEMENT: The change in location of a body from the initial position. Peak-to-peak displacement is equal to the total travel of a steady-state vibration.

FILTER: An electrical circuit used to limit response to certain frequencies without altering the intensity of others to any appreciable degree.

FREQUENCY: The number of vibrations or cycles per unit of time (usually either one minute or one second).

MULTI-PLANE: A balancing problem occurring on extremely long rotors, necessitating balancing in several planes.

OUNCE-INCH: A term used to express the amount of weight versus the distance from the center of the rotating part where it should be placed.

PICKUP, VELOCITY: A transducer for converting mechanical motion into an electrical impulse. It has an output which is instantaneously proportional to the velocity of the motion being measured.

PROBE: A mechanical extension of the pickup. Enables the operator to reach narrow or small areas where the pickup otherwise would not fit.

SINGLE-PLANE: A balancing problem which involves a rotating part with a diameter which is large as compared to its length.

TWO-PLANE: A balancing problem which involves a rotating part that is relatively long as compared to its diameter.

UNBALANCE: A state of unequal mass distribution in a rotating component so that balance does not exist.

VARIABLE FILTER: One in which the frequencies to be accepted or rejected can be continuously adjusted over a given range.

VIBRATION ANALYSIS
WORLD-WIDE
IRD
CONSULTING SERVICE
IN-PLACE
DYNAMIC BALANCING
HEADQUARTERS
WORTHINGTON, OHIO
614/885 5376